Report of

Hazen, Whipple & Fuller on

Durham Water Company, Durham, N.C.

Jan. 1, 1916.

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ON

Durham Water Company

Durham, North Carolina

With Appraisal of its Plant as of
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Correspondence Preceding Report

[LETTER]

CITY OF DURHAM, November 13th, 1915.

Mr. Charles F. Batchelder,
Durham, N. C.

DEAR SIR:

Upon your statement that you are representing the Durham Water Company and Messrs. E. H. Rollins & Son, of Boston, I am directed by the Special Committee from the Board of Aldermen of the City of Durham to request through you permission of the Durham Water Company to have the engineers of the City of Durham inspect and appraise the Durham Water Company's plant and system, and to have inspected and, if necessary, audited the books of the Water Company, both here and in Boston. It is, of course, understood that the City of Durham will bear the cost of this inspection and appraisement.

This request is made because the Board of Aldermen desires to enter into a satisfactory arrangement for the purchase of the properties of the Durham Water Company, and therefore desires to get a fair and equitable estimate of all values of the Water Company as a basis on which to submit a bid for its purchase.

If we are granted the permission to make the inspection and appraisement as requested, it is our intention to proceed with this work as soon as possible.

Yours truly,
(Signed) J. L. MOREHEAD,
City Attorney.

APPROVED:
(Signed) B. S. SKINNER, *Mayor.*

[TELEGRAM]

NEW YORK, November 15, 1915.

B. S. Skinner, Mayor, and J. S. L. Morehead, City Attorney,
Durham, N. C.

Answering your letter to Batchelder, November thirteenth. Water Company glad to have their property valued and books opened as follows:—Hoping to save time, avoid all possible disagreements, have some finding which will eliminate all criticism and command confidence on all sides Company will agree this investigation shall be done at once by your representative and theirs acting jointly in conference.

Company will select Hazen, Whipple and Fuller as high grade, independent, unprejudiced representatives. Wire me Boston when your engineer will be ready to start and we will instruct Hazen to act accordingly.

JOHN D. HARDY.

[TELEGRAM]

DURHAM, N. C., November 16, 1915.

John D. Hardy,
11 *High St., Boston.*

Your wire, November fifteenth. We are pleased to note your expression of willingness to allow the City under certain conditions to make examination of your property and books in order to secure the necessary information on which to base a price which we hope will be satisfactory to yourselves. In your selecting Hazen would you expect the City to pay his charges.

J. L. MOREHEAD,
City Attorney.

[TELEGRAM]

BOSTON, November 17, 1915.

J. L. Morehead, City Attorney,
Durham, N. C.

Your wire of yesterday received today. Thank you. We expect to pay Hazen. Will instruct him to go to Durham on receipt your wire.

JOHN D. HARDY.

[TELEGRAM]

DURHAM, November 19, 1915.

John D. Hardy,
11 High St., Boston, Mass.

Your wire seventeenth. Our engineer can start week beginning November twenty-ninth. Our understanding is that this inspection is made without prejudice to either party and while it is made by engineers working together their estimates and reports may be made separately.

J. L. MOREHEAD,
City Attorney.

[TELEGRAM]

BOSTON, November 20, 1915.

J. L. Morehead, City Attorney,
Durham, N. C.

Am asking Hazen, Whipple and Fuller to be on hand November twenty-ninth. My understanding same as yours namely: inspection and appraisement are made without prejudice to either party and while they are made by engineers working together their estimates and reports may be made separately. I hope they will agree and unite in one report.

JOHN D. HARDY.

INSTRUCTIONS TO HAZEN, WHIPPLE AND FULLER

BOSTON, November 22, 1915.

Messrs. Hazen, Whipple and Fuller,
30 East 42nd Street,
New York City.

GENTLEMEN:

The City of Durham, North Carolina, through its officers has asked permission to value the property of the Durham Water Company and to inspect its books. It asks this because its Board of Aldermen desires to enter into a satisfactory arrangement for the purchase of the properties of the Company and therefore desires to get a fair and equitable estimate of all values of the Water Company as a basis on which to submit a bid for its purchase.

The Company has been glad to agree that this investigation be made at once by the representative of the City and the representative of the Company, acting jointly in conference.

It is agreed between City and Company that this inspection is made without prejudice to either party, and while it is made by engineers working together their estimates and reports may be made separately. I hope however that the City's engineer and yourselves may agree and join in one report.

Though you have been known to me by reputation only, because that reputation accords to you high character and efficiency in water works matters and in the general practice of your profession, in anticipation of the agreement just concluded with the City and to save time, I already have asked you briefly if you could go to Durham and you have said you would if you should be called on to do so.

The City's representative will be ready to start on this appraisement in the week beginning Monday, November 29th. Will you please be in Durham to start on that date on the work desired.

The Company wishes to put everything it has without reserve at the disposal of yourselves and the City representative. Data on the physical properties of the Company will be found in Durham as well as all of its books of accounts except the treasurer's books in Boston. These will be sent to Durham whenever they are wanted.

I have no directions to give. You will use the means and methods in reaching a just and fair valuation of Company's property, exclusive of cash balance and bills and accounts receivable and payable, which you think best and which are sanctioned by best practice in similar cases.

Col. J. C. Michie, the superintendent of the Company, in whose integrity you may put absolute confidence, will extend to you all the resources of his office.

Yours very truly,

(Signed) JOHN D. HARDY,
Receiver, Durham Water Company.

Report on the Value of the Property of the Durham Water Company Durham, N. C.

February 24, 1916.

John D. Hardy, Esq.,
Receiver, Durham Water Co.,
Durham, N. C.

Sir:

In accordance with your instructions, we have examined the property of the Durham Water Company and made an estimate of its value. In our judgment, the fair value of the property as of January 1, 1916, is $589,000.

In placing this value on the property, we have taken into consideration the fact that the city of Durham has started the construction of works for a water supply on Flat River and that the company must anticipate competition in the future. If the company were to continue its business in the future as it has in the past, without competition, charging fair and reasonable rates for water, the value of the plant would be greater than the sum which we have given above. We have examined the income and operating expenses of the company; have made an estimate of the cost of the improvements and extensions which are needed to put the plant into thoroughly good condition; and find that the prospective net earnings of the company in the future will be sufficient to render a return on $589,000 which will be larger than the rate of interest usually received from water works properties.

We recognize the fact that it will be better for both the company and the city to avoid competition, and believe that this value which we have given, although it is less than the business is worth under conditions which existed before the city decided to build its own plant, represents a fair value under the present conditions. This value is substantially the estimated cost of reproduction of the property, less a fair allowance for depreciation, plus the cost of obtaining the business which the company now has from its consumers which are connected to its pipes, and the value of the unexpired franchise.

Competition in supplying water to a city is economically wrong. It results invariably in waste due to duplication of works and labor. It results ultimately in poorer service and higher rates to the consumers than would otherwise be the case. In every instance where competition has actually taken place the results have been unfortunate

for all parties concerned. Fortunately there are but few such cases, as usually those who have been in control of water companies and municipalities have appreciated the situation, and private works have been taken over by the municipalities at a value arrived at through agreement or through arbitration or condemnation proceedings.

Our understanding of the contention of the City of Durham, as indicated to us by Mr. Gilbert C. White, its engineer, during our conferences, is that the city having decided on the Flat River water supply, has no use for some parts of the company's property on the Eno River.

Under these conditions, the city claims that the company should take part of the loss which will be involved if the Eno River plant is given up. This condition is one created by the city itself. In our opinion, the Eno River supply is the better one for the city. It is clearly a more economical one, both as to construction of works and as to operation of them. The quality of the water from the Flat River and from the Eno River is, under present conditions, substantially equal. In the future, the additional safety provided by the storage reservoir which is planned for the Eno River supply will render the supply a better one from the standpoint of sanitary protection than the supply from the Flat River, unless corresponding storage is provided on that stream. With adequate purification, which can readily be obtained, either river will render a satisfactory supply. With the storage possible above the company's property on Eno River an adequate quantity of water for Durham for the future is assured. Under these conditions, it seems to us that any attempt to reduce the value of the property below that which we have given as the fair value is not equitable.

For your information we have drawn up a schedule of the reproduction cost of the items of the property owned by the company which would immediately come into service if the Flat River supply were connected to the company's mains as is now proposed. Besides these items, there is at the Eno River Station a considerable amount of equipment which the city could make use of to advantage in connection with the supply works at Flat River. We have estimated the saving to the city if these items were used on the basis of the cost of reproduction less the depreciation and less the cost of removing and hauling the equipment to the site of the Flat River works. The 12 inch force mains from the Eno River plant to the reservoir could be taken up and relaid in the pipe system. We have estimated the value of this pipe on this basis, deducting from its cost first its depreciation and then the cost of taking up and hauling the pipe.

We have estimated the remaining equipment at Eno River at the amount for which we believe it could be sold either for use for other purposes than water supply or for scrap.

Taking these values together, we obtained a figure of about $504,000, as shown on Table T-39.

MAINTAINABLE NET INCOME

One of the most important elements in the valuation of a water works plant is its power to earn. It is necessary to determine whether the plant is able to maintain a satisfactory net income under fair and reasonable rates while it is giving adequate service. In order to ascertain this, it is necessary to estimate the probable future growth of the city and the probable future earnings and expenses. It is not necessary to carry this estimate for a long time into the future, but only to such a time as the plant can be put in thoroughly good condition.

In Table T-30 we have shown the past and estimated future population of Durham and of the district supplied by the Durham Water Company, together with the past and estimated future earnings and expenses.

It is the experience of nearly all cities that the earnings of a water plant increase at a more rapid rate than the population. This is because people are constantly using more water for all purposes and because the percentage of people which are not connected to the plant is growing constantly less.

We believe that the figures given in Table T-30 are below those which will actually be obtained in the future. These figures are taken as conservative ones which will be reasonably certain to be reached or exceeded. In Table T-31 we have shown the estimated cost of operation and earnings for the next five years, together with the estimated cost of constructing new works required to put the plant in thoroughly good condition, and the estimated cost of extensions to meet the increased demand for water. After allowing for a fair return on the additional investment required, there remains during these five years an average net income sufficient to return 7% on $611,000. This would allow 1% to be set aside for depreciation and 6% to be paid out. If the Company gives up the water works to the City, it will mean the sacrifice of an investment, built up after years of struggle, which is worth $611,000. If the City should take these works, put them in thoroughly good condition, and operate them as the water company has done, it could earn a substantial profit, as it could obtain the money at a comparatively low interest rate, and would save in taxes.

ENO RIVER AS A SOURCE OF SUPPLY

We have examined the Eno River and the Flat River as regards their availability for water supply for Durham. In our opinion the Eno River is the better supply and should be continued in use by the city. The source of the supply is closer to the city and is at a higher

elevation than the Flat River. It is, therefore, clearly a cheaper supply, both as to the cost of development and the cost of operation. It will always retain this advantage and the greater the amount of water that is used in Durham, the greater will be the difference between the expense involved in the two supplies.

The quality of the water as obtained from the two rivers is under present conditions substantially equal. Neither supply will be satisfactory without purification and either of them will be satisfactory if proper purification is secured.

On the Eno River near the company's plant there exists an exceptionally good location for a large storage reservoir. By the construction of a dam some 40 feet in height some 600 million gallons of water can be stored. This amounts to about 300 days' storage of water at the present rate of consumption in Durham. The construction of this reservoir will increase the available supply for the City, will provide additional water power for pumping, and will improve the quality of the water.

With this storage provided, the Eno River will furnish a sufficient quantity of water for the city of Durham for a great many years to come. A city of 100,000 to 150,000 population or more can be supplied from the Eno River with this storage available. There are other sites where reservoirs could be constructed in the distant future, so that the Eno River will suffice as the Durham supply for an indefinite period.

The construction of this dam will materially benefit the quality of the water. The benefit of long storage is well recognized among those who have had experience with the water supplies in this country and abroad. Many cities, including such cities as New York and Boston, rely on storage to protect them against pollution of the water from streams flowing through country far more thickly populated than the water shed of the Eno River. Neither of these cities has a filter plant. The effect of storage has been studied with great care by the officials in charge of the water supply for the city of London, England. London obtains its water supply from streams upon the catchment areas of which there is a very large population residing. It stores this water and then filters it, thus obtaining an excellent water. The advantage of the storage of water in reservoirs is shown by the experience of the Metropolitan Water Board of London. This has been ably set forth by Dr. A. C. Houston, the Board's Director of Water Examination, who has made continued studies for the Board since its consolidation over ten years ago. As a result of Dr. Houston's observations over a long period, the following extract, taken from his book entitled "Studies in Water Supply," page 96, may be quoted:

"It is impossible within the compass of this work to do more than

condense the chief points showing the advantages accruing from the simple storage of raw river water:

(1) Storage reduces
  (a) The number of bacteria of all sorts.
  (b) The number of bacteria capable of growing on agar at blood heat.
  (c) The number of bacteria, chiefly excremental bacteria, capable of growing on a bile-salt medium at blood heat.
  (d) The number of coli-like microbes.
  (e) The number of "typical" B. coli.
  (f) The amount of suspended matter, colour, ammoniacal nitrogen and oxygen absorbed from permanganate.
  (g) The hardness.

(2) Storage alters certain initial ratios, for example:
  (h) It reduces the number of "typical" B. coli to a proportionately greater extent than it does the number of bacteria of all sorts.
  (i) The colour results improve relatively to a greater extent than those yielded by the permanganate test.

(3) Storage, if sufficiently prolonged, devitalises the microbes of water-borne disease, e. g., the typhoid bacillus and the cholera vibrio.

(4) Storage produces a marked "leveling" or "equalizing" effect.

(5) An adequately stored water is to be regarded as a "safe water," and the "safety change" which has occurred in a stored water can be recognized, and demonstrated by appropriate tests.

(6) The use of stored water permits of a constant check being maintained on the safety of a water supply *antecedent* to, and irrespective of, filtration.

(7) The use of stored water goes far to neutralize or wipe out the gravity of any charge that a water supply is derived from polluted sources.

(8) The use of adequately stored water renders any accidental breakdown in the filtering arrangements much less serious than might otherwise be the case."

Not only would the long storage materially benefit the water as to its sanitary quality, but it would make the operation of filters simpler and cheaper. It would serve to dilute any small mill wastes which now enter the Eno River, so that the water would not be subject to any

sudden changes as to alkalinity. With this storage provided on Eno River, the quality of the raw water would be superior to that from the Flat River unless an equivalent amount of storage were there provided.

By the construction of this dam, a large increase in the available water power would be obtained. We have examined the records of the Durham Water Company as to its pumpage by water power in the past, have examined the records of stream flow for streams in the vicinity of Durham and have estimated that from 80 to 90 per cent of the total water used by Durham at the present time could be pumped by water power with the increased head and water made available by the construction of the storage reservoir. We have estimated the cost of this improvement and find that the saving effected by the use of the water power is sufficient to furnish a fair return on the investment involved. The construction of this reservoir would, therefore, not reduce the available net return to the company. In the future, as the consumption of water increases, the value of the water power would be greater.

REPRODUCTION COST

Our estimate of the cost of reproduction of the physical plant is based on conditions as they existed on the date of this appraisal, January 1, 1916, and upon normal prices. By normal prices we mean the prices which have on the average prevailed during recent years and which may reasonably be anticipated in the immediate future. We have not used the prevailing prices at the exact date of appraisal as prices fluctuate with the market while the values of water works properties do not. Using normal prices gives the normal reproduction cost. For this appraisal it would have been distinctly advantageous to the Company if the present higher prices of material had been used. For instance, the cost for cast iron pipe in the system, excluding any cost for laying, has been estimated at about $180,000. If the prevailing price as of January 1, 1916 had been used, this would have been increased by about $8,000. The prices used are intended to be sufficient so that the works could be actually built for them by the company or by the city under careful business management. They are intended to include reasonable compensation for all material and labor used, including a profit for such contractors as would naturally be employed. They do not include any profit to the company, but only the actual net cost in money to the company.

We have obtained all the information which we could as to the actual cost to the company of the various items in the plant. We have given these prices due consideration in making up our reproduction cost. In many cases our estimates of reproduction cost are materially less than the actual cost to the company, because we have estimated on the cost of doing work under contracts of considerable

magnitude, while the work has actually been done piecemeal at a greater cost.

In making our estimate, we have made a careful study of the conditions existing in Durham as affecting the cost of doing the work. We have studied the cost of laying pipe and doing other work in Durham and in other cities and towns in this section of the country. We have also considered the data furnished us by Mr. White as to contract prices for laying pipe lines and other works.

PIPE LAYING

It must be remembered in comparing pipe laying prices that the difference in the character of the excavation, the difference in the labor conditions, the amount of congestion in the streets, and other matters, affect them materially. Prices obtained for easy digging, or those obtained for laying pipe in small villages and in the outlying sections of cities cannot be used without modification for conditions which exist in Durham.

The estimate which we have given we consider to be as low as it would be possible to lay pipe in Durham by a contractor in a thoroughly workmanlike manner, with a reasonable profit, under normal conditions.

In considering prices which have been secured in the last few years, it must be remembered that contract work has been scarce and that contractors have taken work in many cases at little or no profits. Such conditions will not continue and are not normal conditions. It must also be remembered that many contracts are taken at too low a figure. Generally when this is done, the contractor, finding that he is losing money, does poorer work than would otherwise be the case. In this way the owner also suffers.

We believe that it is not a fair basis of valuation to take the lowest prices which can be obtained in competitive bidding. These prices are well known not to represent the cost of pipe well laid; they do not cover the many extras which come into the case, and do not cover the frequent additional expense due to the fact that in many cases the bondsmen have to finish the contract; they do not cover the cases where the contractor receives as extras an amount which makes the actual cost materially in excess of that obtained by using unit prices taken from his bid. These facts are well recognized by the courts and commissions which have had experience in valuation.

In comparing the cost of laying pipe in Durham with the cost of laying elsewhere in the vicinity, it must be remembered that the excavation in many places in the South is comparatively easy and can be done at a lesser cost than would be required for the work in Durham. A certain proportion of the excavation in Durham will be

sand rock, which will require considerable additional expense, although it may not be classed as hard rock excavation.

Some of the pipe laying in Durham will cost much in excess of the figure which we have given. At places where the streets are congested, where difficulty will be met with in handling the material, where unforseen underground obstructions are encountered, where trolley tracks and railroads will have to be crossed, and where other obstructions are encountered, there will be much additional cost. If a contract was let for pipe laying, under the conditions ordinarily found in small villages, the overcoming of all of these difficulties would be extra work and would amount to a large proportion of the cost of laying. We have estimated a figure of from 2 to 3 cents per foot for all the pipe in the city for the additional cost of overcoming these obstacles. In some streets of the city the cost will be more than double the cost in others and this allowance is taken as an average figure. In cities in the North of similar size and character as Durham, but with somewhat more difficult conditions, the estimate has frequently been 5 and 6 cents per foot for the same item.

CAST IRON PIPE

In obtaining a proper cost to allow for the cast iron pipe in the system, we ascertained the prices which the company has paid the last ten years and prices which have been paid elsewhere in this locality. We find that in general the prices thus obtained agree very closely with New York tidewater prices during times when prices are not abnormally high or low. The prices in the South do not, however, go to quite the low levels that the New York prices do. This fact has been noted not only in Durham, but elsewhere, and it is probable that the pipe manufacturers are able to somewhat control the prices and keep them from going to the low levels which are the direct result of strong competition. We have taken for cast iron pipe a price per ton of $26 for 6″ pipe. This represents the average price at which pipe could be obtained at Durham during the past ten years. This price is materially less than the present price of cast iron pipe in Durham. The quotation on January 1st for pipe in Durham was at the rate of $27 per ton. Since that time the price of pipe has increased and it is likely that it will further increase. The average price for the past ten years is clearly a conservative estimate.

In this connection it may be noted that the pipe which the Durham Water Company has placed has been thoroughly tested out. It has been in the ground and tested under conditions equivalent to any which it will have to stand. Such pipe as was of poor quality has broken and been replaced. The pipe that is in the ground is equivalent to pipe which has been thoroughly tested at the mill. The cost of such testing is considerable, but no allowance is made for it.

During the life of the company, the grade of streets has been changed from time to time and the company has had to lower the pipe to meet these changes in grade. No allowance has been made for this, but it may be mentioned as one of the points which should be fairly considered if the actual cost to the company for construction work were to be taken.

SPECIALS

The price taken for specials is 2.8 cents per pounds, which is approximately the average price paid for specials during the last ten years.

LEAD

We have used 5¼ cents per pound as the proper cost of lead, which represents a normal price for this material in Durham.

GATES AND HYDRANTS

We have studied the actual cost of gates, hydrants and appurtenances to the water company and have compared them to prices which prevail elsewhere. These prices are reasonable ones and we have used them. In the case of the connections which the company has made with the Smith tapping machine, we have considered that these would be replaced, if new works were built, by ordinary specials and gates. The object of the tapping machine is to make the connections against pressure, thus avoiding shutting off the pipe. For new construction this would not be necessary and we have estimated on the cheaper method of doing the work.

SERVICES

The original cost of installing the service pipes has been paid by the consumer, the company making the tap and charging a nominal price for it.

The services have been maintained by the company. Many of them have been replaced. In some places where new mains have been laid to replace older mains, all the services have been taken out and largely replaced. That the company does have some ownership in these servics is clear. This point has been frequently brought up before courts and allowances have been made. No specific allowance has been made for this item in our estimate. We have considered this as one of the intangible values of the property.

ADDITIONAL COST OF LAYING MAINS UNDER PAVING

We have made an allowance for the cost of cutting and replacing paving which exists in the streets over the pipe lines. If a new water works pipe system were to be laid now, it would be necessary to cut this paving, to save the material so far as it could be used again, to

take precautions in backfilling the trench so that settling would not result, and to replace the paving as nearly as possible in its present condition.

WROUGHT IRON AND APPURTENANCES

Considerable quantities of wrought iron pipe, on which we have put a present value of $15,667, have been laid in the section of the city where the amount of business to be obtained was not sufficient to render a fair return on the investment required for larger cast iron mains. The laying of this pipe is common practice in cities of the South and is fully justified under the existing conditions. Ultimately, as the business increases, much of this pipe may be replaced by cast iron mains. In the interval, however, the saving in interest on the investment will cover the cost of the pipe.

METERS

The estimated cost of reproduction of the meters is considerably less than the actual cost to the company. The unit prices allowed are those for which a large quantity of meters, such as would be required if the plant were reproduced as a whole, would be purchased and installed. We may call attention to the fact that the price thus allowed for meters is less than has generally been made in appraisals.

STRUCTURES AND EQUIPMENT AT ENO RIVER

We made a study of the actual cost of the structures and equipment at the Eno River Station and have used the actual cost to the company for items whose cost represents normal prices under present conditions. In many cases the information as to the actual cost is not sufficiently complete to enable it being used. In such cases we have estimated the reproduction cost. We may call your attention to the fact that the older machinery and the filters have been depreciated largely, as they are approaching the end of their usefulness. Details of the estimate for the Eno River plant are given in schedule on Page T-2.

The amount of equipment installed in the pumping station in the last three years has been large, and as a result the average age of all the pumping equipment is but 6.2 years. The average age of the buildings is 13 years.

RESERVOIR

The estimated reproduction cost of the distribution reservoir has been taken as the cost to build under normal prices of labor. We have considered that the reservoir would, if reproduced now, probably be built cheaper of concrete instead of stone masonry, and have accordingly made our estimate lower.

ENGINEERING AND CONTINGENCIES

We have allowed 12½ per cent of the base cost of structures for engineering, administration, contingencies and errors and omissions. This allowance is intended to cover the cost of the services of engineers, administrative officers, lawyers and others whose services are required for the planning and building of the works, the errors and omissions from the inventory and the many items of expense which have to be met with during construction of the works and which cannot be well foreseen.

INTEREST DURING CONSTRUCTION

Six per cent for interest during construction is allowed. It is assumed that it will take two years after the construction of the plant is started before it could be put into actual service. The money to pay for the construction work would have to be advanced from time to time during this interval. Interest on this money must be paid. On the payments for some of the early work a full two years' interest will accrue, while for the last payments there will be practically no interest. The figure used represents an average for the whole system.

LAND, WATER RIGHTS AND EASEMENTS

For land, water rights and easements, we have used for the reproduction cost, so far as it can be ascertained, the actual cost of these items to the company at the time of purchase. No allowance for value due to favorable location or usefulness for water supply purposes has been made. We have allowed 5 per cent overhead charge on the land to cover surveys, legal and administration expenses connected with its acquisition. We have allowed 6 per cent interest per annum for two years on the land, as it would be necessary to acquire all the land before the plant was started and the interest would accrue during the entire construction period.

GOING VALUE

Going value may be defined as that which represents the difference in value between the pipes connected with consumers and earning revenue and a corresponding system of pipes equally complete but without actual connections or contracts or revenue. The difference in value is represented by the difference in revenue that the two plants otherwise equal would secure, one with the full businss attached and the other with the business to be acquired.

It may be accepted as a fact that almost any water company during its early years fails to make a fair return on the capital invested and that there is an actual cost to the company in acquiring the business. That it cost the Durham Water Company a much larger amount to acquire the business than we have estimated as the going

value is evident from the financial records of the early years of the company's existence.

The amount of going value may be estimated by considering the history and the probable future of the present plant and comparing it with another plant similar in all respects except that at the start it would be without business. The difference in the net earnings of the two plants reduced to its present worth is the amount of the going value. The details of this computation for obtaining going value are shown in Table T-32.

Valuable information as to the rate at which new water works are able to acquire business is furnished by the experience of the City of New Orleans, where a new water works plant was built in its entirety and put in service as rapidly as possible. This plant was started early in the year 1909. Prior to that date there was a small water company which furnished muddy Mississippi River water to a small percentage of the population. Practically the city depended on cisterns for its water supply for domestic uses. The need for a satisfactory water supply was urgent, as it was generally recognized that the use of cisterns had much to do with the unsatisfactory health conditions in the city. In order to make the use of the water as general as possible, unusually low rates were charged. In spite of all the favorable conditions for acquiring the business, it has taken six years to get 82 per cent of the premises connected to the pipe system.

In Table T-36 we have shown the statistics taken from the official reports of the New Orleans Water Department as to the rate of acquiring the consumers. In the last column of this table we have shown for comparison the rate at which we have estimated that the business would be acquired in Durham if a new water company should start busines at this time. It will be noted that the rate which we have estimated is much more rapid than that which actually resulted in New Orleans. Our estimate is a conservative one and under the conditions existing in Durham the business could scarcely be acquired more rapidly than we have assumed and might come much more slowly.

ADVANTAGES TO THE CITY NOT CONSIDERED IN THE ESTIMATES

There are many elements involved which make it more desirable for the city to acquire the Durham Water Company's plant in preference to building a new distribution system. Among these may be mentioned the following:

The present pipes are tapped for house services. If a new system were installed by the city, the cost of this tapping would have to be borne by either the city or by the consumers. The service pipes are now installed and connected to the taps on the company's mains. Ir-

respective of the ownership of these services, it would be necessary to have them connected to the new system. In making the change from the present system to the new system, many of the old pipes which are now and will remain for some time entirely serviceable would be broken or would be made to leak. It would be found that much expense would be involved in changing these services from one system of pipes to the other. As we have already mentioned in the report, the company has replaced many of the services and can justly claim at least partial ownership in them.

In order to install the new distribution system, every street in the city would have to be dug up while the new pipes were being laid. During the progress of the work, more or less damage would be caused to the property of other utilities and to private property. Actual loss of business due to the bad conditions of the streets always results from such work. It is, moreover, inconvenient and annoying to the entire population. To have the streets of the city in such condition means that each individual person suffers to some extent. These matters are not given any specific value in this estimate, but they should be considered by the city in considering the purchase of the plant at a fair value based on the other elements of value of the plant to the company.

FRANCHISE VALUE

Under the terms of the franchise, the city would normally take the water company's property on April 1, 1918. If the company sells the plant now, it loses the revenues from the business in the interval. If the company by continuing its business can earn a net rate, after paying all operating expenses and a fair allowance for depreciation, which is in excess of the amount of interest which the money obtained from the sale of the plant would earn, it is clear that the company is making a sacrifice in selling the plant at the present time. The difference between the net earnings of the company and the amount earned from a safe investment of the money obtained from the sale of the plant discounted to the present time may be taken as the franchise value. This value has been allowed by the courts in other cases and it has been recognized that the franchise has a value distinct from the going value. We have estimated this franchise value in Table T-37. We may call your attention to the fact that this franchise value is dependent on the value which is placed on the other elements of value in the plant; that is, with a smaller estimated value of the plant a larger franchise value is obtained.

The relation between the franchise value and the value of the plant excluding franchise value, together with the details of the computation of the franchise value, are shown in Table T-37-38.

DEPRECIATION

During the past few years, the matter of the proper depreciation to be allowed on water works plants and other public utilities has been given much consideration by engineers, public utility commissions and the courts. Extended discussions of this matter have been published and a more thorough understanding of it has been obtained than formerly was the case. It has been recognized that methods of depreciation which may be applicable to properties where the units are of comparatively short life and which have to be frequently renewed are not equitable when applied to the long-lived structures involved in water works and similar utilities. The so-called straight line method of depreciation—that is, the method of taking off a fixed percentage of the value of a structure each year, this percentage to be the ratio between the age and the assumed life of a structure, is not an equitable one for use with long-lived structures. The so-called sinking fund method is now generally used. By this method the depreciation is made the equivalent of a sinking fund which, with its accrued interest, will be sufficient to replace the structure at the end of its life.

To illustrate the difference in the two methods of depreciation, it may be useful to consider the more familiar case of a sinking fund for bonds. We have given in the table below the results which would be obtained if the principles involved were applied to such a case.

CREATION OF A FUND TO RETIRE $500,000 OF 50 YEAR BONDS

USING SINKING FUND METHOD		USING METHOD INVOLVING SAME PRINCIPLE AS THE STRAIGHT LINE METHOD OF DEPRECIATION	
Amount required to be set aside each year at 4% interest,		Amount required to be set aside each year,	
	.00655×$500,000=$3,275		$\frac{\$500,000}{50}$=$10,000
Total amount of sinking fund at end of 50 years,		Total amount of fund at end of 50 years, at 4% interest,	
Principal	$163,750	Principal	$ 500,000
Accrued interest at 4%	336,250	Accrued interest	1,026,670
	$500,000		$1,526,670

The first of the above methods is, of course, the one used in providing sinking funds for bonds. It is the proper method and provides

all the funds necessary to pay the bonds. In the second method it will be seen that the amount to be set aside yearly is such that over three times the necessary funds result. Exactly the same will result if the straight line method is applied to depreciation.

Utility Commissions have in many cases advised that the companies should not be required to carry an actual sinking fund invested in other securities, but should rather re-invest the money put aside for depreciation in the plant itself. In this way the money usually can earn a higher rate of return than it could if it were put aside in other securities. As nearly all water companies need extensions and improvements, the money can be thus used to advantage. The Durham Water Company has consistently followed this practice. It has not only put its depreciation fund into its plant, but it has also put the greater part of its earnings into it. The Company has not regularly paid the interest on its bonds, but has instead put the earnings directly back into the plant. Under these conditions it is clear that the company has provided in its plant the full equivalent to a sinking fund.

It is sometimes stated to justify the use of the straight line method that if a piece of property has been used for one-half its useful life it is worth only one-half of its value when new. This statement while plausible is erroneous. It overlooks the fact that we are measuring worth in money, that money earns interest and that the money to be paid now is worth more than money to be paid in the future. If the property is equally useful for supplying water and the conditions remain otherwise the same, the earnings from it will be just as great during the last half of its life as during the first half. Under these conditions, if the straight line method is used, the owner of the property during the first half of its life would have to carry an interest charge on a capital of exactly double that carried by the owner of the property during the second half of its life, while the returns would be the same. In such a case, the owner of the property during the first half of its life might be unable to earn a reasonable interest on the capital, while the owner during the second half made a substantial profit over and above his interest charges. This is clearly unjust, but it is the fact which exists if the straight line method is accepted and used for depreciating public utility properties.

ILLUSTRATIONS OF DIFFERENCE IN RESULTS OBTAINED BY THE USE OF THE TWO METHODS OF DEPRECIATION

In the following table we have shown, using round numbers for convenience, the results obtained by using the two methods of depreciation for a case similar to that existing in Durham.

Assumptions: (Using round numbers for convenience).

Cost of reproduction of physical property, new	$500,000
Useful life of plant	50 years
Age of plant	15 years
Accrued depreciation at end of 15 years, on straight line method	150,000
Accrued depreciation at end of 15 years, on sinking fund method, 4% interest basis	65,579
Cost of reproduction, less depreciation, by straight line method $500,000—$150,000=	350,000
Cost of reproduction less depreciation, by sinking fund method $500,000—$65,579=	434,421

CASE I

USING "SINKING FUND" DEPRECIATION METHOD

Assuming that a city has $500,000 in cash to use and that an existing plant could be purchased for the cost of reproduction less the accrued depreciation at the end of the 15 years, it could either build a new plant for $500,000 cash or purchase the existing one. If the existing plant were purchased, $65,579 the amount of the accrued depreciation could be invested in securities, while if a new plant were built the total amount would have to go into construction. The earnings from the property would be the same in either case. The results to the City are given below:

IF CITY BUILDS NEW PLANT	IF CITY PURCHASES AN EXISTING PLANT, 15 YEARS OLD
Cost to build $500,000	Cost to purchase existing plant $434,421
Value of plant at end of 35 years from date of purchase, using sinking fund method of depreciation, on 4% interest basis, $500,000 less dep. 258,780	Sum which could be invested 65,579
	Value of plant at end of 35 years from date 0
Total value of property owned by city at end of 35 years 258,780	Amount of the principal of $65,579 and compound interest, at 4%, for 35 years 258,780

In the above case it is clear that the city is equally well off at the end of 35 years, whether it builds a new plant or purchases the existing one, and that the method is a fair one for both parties.

CASE II
USING STRAIGHT LINE METHOD OF DEPRECIATION

Using same assumptions as in Case I, except that in this case the amount available for investment in other securities would be $150,000 instead of $65,579.

IF CITY BUILDS NEW PLANT	IF CITY PURCHASES EXISTING PLANT
Cost to build $500,000	Cost to purchase existing plant $350,000
Value of plant at end of 35 years, using straight line method of depreciation....150,000	Amount which can be invested $150,000
Total value of property at end of 35 years $150,000	Value of plant at end of 35 years 0
	Amount of principal of $150,000 with compound interest at 4%, for 35 years......$592,000

From the above it is seen that if the straight line method of depreciation were used, at the end of the thirty-five year period, if the city had purchased the existing plant, the value of its property would be $442,000 more than if it had built a new plant. Such a result is clearly unjust to the company and shows that the allowance for accrued depreciation by the straight line method is excessive.

We may call attention to the fact that in a recent report of the Committee on Valuation of the American Society of Civil Engineers the Sinking Fund Method of Depreciation was recommended and that it is now in general use.

We have used the sinking fund method of depreciation in this appraisal for all structures which we have depreciated in accordance with a definite term of useful life. For some of the structures other methods of determining depreciation are clearly better and have been used. For cast iron pipe, the life of which is unknown, which has in some cities been used over 100 years and which it is generally admitted will last for a very long time, the depreciation can be better estimated by determining its relative usefulness as compared to new pipe. The cast iron itself may be considered as practically indestructible. It is true, however, that cast iron pipe becomes more or less tuberculated with deposits in time and that the carrying capacity of the pipe becomes somewhat less.

Many experiments have been made to determine the loss in carrying capacity of the pipe from this cause. This loss varies with different waters and conditions. We have examined the pipe systems in

many different cities and have determined the loss in capacity for many different pipes. We have depreciated the value of the pipes in the Durham Water Company's system on this basis. Evidence as to the condition of the pipe is furnished by specimens of the pipe removed and also by the fact that the friction in the pipes of the supply mains is not large. The tuberculation in some of the pipes is undoubtedly greater than in others. A piece of the original pipe taken from the 12 inch force main from the pumping station to the reservoir, laid some twenty-eight years ago, shows very little, if any, tuberculation after this period of service. There is a thin layer of dirt in the bottom of the pipe. Its carrying capacity is practically as great as when it was put down. The tar coating originally put on is still in good condition. The value of this pipe is little, if any, less than when it was put down. On the other hand, we have examined a piece of pipe which was taken out of the system, which is also twenty-eight years old, on which there are considerable tubercles. This piece of pipe was in the early days on a dead end, and for some time was used to only a limited extent, although now considerable quantities of water go through it. The fact that the water in the dead end was not in motion enabled the deposits to form easier than at other places. The average condition of the pipes is somewhere between these two extremes. The tuberculation on these pipes is probably not materially different from the average of pipe throughout the country.

We have depreciated the pipe lines to a greater extent than would be justified on the theory of reduced capacity alone, because we realize that due to strengthening of the distribution systems which is required from time to time as cities grow, there is always a small percentage of the pipes which are either taken up and replaced by larger mains or duplicated. While the amount of pipe affected by such changes as might now be reasonably made in Durham is small, we have made allowance for it. We have also depreciated some lines which are unnecessarily in duplicate, as the two pipes could be replaced by one larger one at a smaller cost.

We may call attention to the fact that the pipes in the streets of Durham which have been laid for some years occupy a position of assured stability and have been thoroughly tested under actual service conditions and in that way are better than pipes just laid. Depreciation has been allowed for gates, specials, cutting and replacing paving on the same basis as the pipe in or over which they are laid.

In depreciating machinery and other structures, we have given due consideration to functional depreciation (that is, where the machinery or structure is of a type not as well adapted to the service it is rendering as other types of machinery now available would be, we have depreciated its value for that reason.)

We have not allowed depreciation on structures which are of permanent construction and are fully useful. We consider dams and reservoirs under this class.

The Nancy Rhodes pond has been depreciated because it has been gradually filling up. We have taken a depreciated cost based on a low estimate of the original cost of this pond and on the cost of removing the sediment now in it and obtaining a storage capacity equal to the original capacity. Nancy Rhodes pond has served a very useful purpose to the company and will continue to be useful as a coagulating basin so long as the plant is used. This large reservoir is more useful than any smaller reservoir which could be built in another location for the same cost. It is worth more than the depreciated value allowed. No additional claim has, however, been made on this account. If it were desired to have the original storage which was available on Nancy Rhodes pond, it could be obtained by removing the sediment in it. Similar basins are used at other plants and are cleaned out from time to time as the additional capacity is needed. The deposit in such basins is light and is easily removed by pumps at small cost. A few thousand dollars will suffice to excavate this basin to its original capacity and this can be done by the company whenever it is thought desirable.

The distribution reservoir is worth more to this system or to any system for water works in Durham than it cost. We have given no depreciation on this structure, (except a small amount on the fence) because it is as good now as it was when it was built.

INVENTORY

The inventories of the various items of the property which make up the plant were made under the direction of our office. Mr. Chester M. Everett, a member of the firm, was in charge of the work. A thorough inspection of the property and an examination of the records of the company was made, and every effort made to get the inventory as complete as possible. In obtaining the inventory for the plant at Eno River and of the distribution reservoir, Mr. C. E. Bosch, representing Mr. Gilbert C. White, co-operated with Mr. Everett. Mr. W. M. Piatt, who was employed by the company for the purpose, measured the streets to ascertain the actual length of pipe in the ground. Schedules of the gates and of other appurtenances were obtained from actual inspection. The schedules thus made up were checked from the records of the company and by employees of the company who were familiar with the system. During the conferences with Mr. White the company offered to uncover pipes in the distribution system at twenty different places, to be selected by Mr. White, in order to establish the accuracy of the schedules. It also offered to cut out pieces of pipe from the distribution system at

any points which Mr. White might select in order to show the actual condition of the pipe in the system. These offers were not accepted by Mr. White.

In the valuation of the property we have included $13,986 as the value of the materials and supplies on hand. The inventory for these items was made by the company. We have used the amount furnished us without checking it, as the items which go to make up this inventory will be different at the time the plant is taken over and it is likely that a new inventory will be necessary at that time.

CONCLUSIONS

The Durham Water Company was started in 1886 and we understand first served the city with water in 1887. Since that time, or for a period of twenty-nine years, the company has continued to supply the city. During the early years Durham was a small place. The records of the company clearly indicate that for many years the water works did not earn enough to make any considerable return on the capital invested. The city has grown rapidly and the company has enlarged and improved its plant to meet the increased consumption of water.. It has to a large extent put its earnings into increased plant. If a fair value is now obtained for the Durham Water Company's plant, it will allow a return of the original investment, together with a moderate interest on it for the full period during which this capital has been used to serve the public.

The early years of a water works company are always full of difficulties, and it is seldom that adequate returns are obtained during them. Unless a fair return in later years is secured or a fair value of the plant is obtained in case of purchase, the investors in water works properties are not fairly compensated. It should be recognized that those who build and operate public utilities companies with all the attendant risks and troubles, and who devote their time and attention to the business are entitled to reasonable pay for their services and for the capital invested. Unless a fair value is paid to the Durham Water Company it will have carried the business during the unprofitable years during which the city was building up, and be deprived of the rights to operate the business when it becomes reasonably profitable. It should be remembered that the City of Durham could not have been built up to its present size and importance without a water supply and it is clearly but just that the capital used for the benefit of the city should be returned with a fair interest.

Under the existing conditions, our judgment is that the fair value of the plant as of January 1, 1916, as between a willing buyer and a willing seller, is $589,000. This value is a conservative one. The seller gets the return of the capital he has invested, together with a moderate interest thereon, while the buyer gets a going business which

will render an adequate return on its value at the present time after all necessary improvements have been made, and which is capable of being further developed so that it will render a greater return in the future.

We consider this a fair value of the plant as a going concern with all its business and rights.

Respectfully submitted,

HAZEN, WHIPPLE & FULLER,

By WESTON E. FULLER.

ESTIMATED COST OF REPRODUCTION OF PHYSICAL PLANT, AND ESTIMATED DEPRECIATION THEREON

ITEM	Supporting schedule, page	Estimated cost to build at present time	Approximate average age, years	Depreciation	Cost to build less depreciation
ENO RIVER PLANT:					
Power dam	T-2	$ 3,120	28	$ 200	$ 2,920
Nancy Rhodes Pond	T-2	6,560	28	2,560	4,000
Buildings	T-2	19,704	13	6,024	13,680
Equipment	T-2-3	44,014	6.2	11,574	32,440
Filters	T-3	13,150	17	7,250	5,900
Distribution reservoir	T-4	16,000	28	100	15,900
Supply and force mains	T-5	107,838	19.2	10,350	97,488
DISTRIBUTION SYSTEM AND MISCELLANEOUS PIPING:					
Cast iron pipe, etc.,	T-6	$192,243	14.8	$15,226	$177,017
Wrought iron pipe, etc.,	T-6	18,383	6.3	2,716	15,667
Hydrants	T-6	7,423	13.5	1,477	5,946
Meters	T-6	19,076	8.9	4,883	14,193
Meter boxes	T-6	2,343	8.5	476	1,867
Fire Station	T-12	7,820	18	6,820	1,000
Telephone Line	T-12	815	5	200	615
Sum		$458,489		$69,856	$388,633
Engineering and contingencies, 12½%		57,311		8,732	48,579
		$515,800		$78,588	$437,212
Interest on construction, 6%		30,948		4,715	26,233
		$546,748		$83,303	$463,445
Land $14,000					
5% overhead 700					
$14,700					
Interest 12% 1,764		16,464		0	16,464
Total estimated cost of reproduction of physical plant		$563,212		$83,303	$479,909
Supplies and materials on hand, as per company's inventory					13,986
Going Value	T-32				85,750
					$579,645
Franchise Value	T-38				9,638
Total					$589,283

ESTIMATED COST OF REPRODUCTION OF ENO RIVER PLANT

ITEM	Supporting schedule, page	Estimated cost to build at present time	Age, years	DEPRECIATION Total per cent	Total amount	Cost to build less depreciation
Power dam	T-14	$3,030	28	6.6	$ 200	$2,830
Excavation, tail race...	T-14	90	28	0	0	90
Nancy Rhodes Pond...	T-14	6,560	28	39	2,560	4,000
BUILDINGS:						
Water power house.	T-15	3,900	18	42.35	1,652	2,248
Filter house	T-15	4,963	Av.16	49.57	2,460	2,503
Pumping st. house..	T-15	7,141	Av.10	18.93	1,351	5.790
Dwelling	T-15	1,200	23	34.30	411	789
Club house	T-15	500	10	19	95	405
Alum shed	T-15	100	2	3	3	97
Office building	T-15	50	2	3	2	48
Oil house	T-15	150	2	3	5	145
Chemical house	T-15	100	2	3	3	97
Dwelling	T-15	1,600	3	2.61	42	1,558
Sum..........		$19,704			$6,024	$13,680
EQUIPMENT:						
WATER POWER:						
1 35″ Leffel Wheel..	T-16	2,465	15	32.5	800	1,665
1 15″ Holyoke Wheel	T-16	825	9	16.6	137	688
1 Bethlehem power pump	T-16	2,992	10	60	1,792	1,200
STEAM EQUIPMENT:						
Corliss engine	T-16	2,057	9	30	617	1,440
Beth'm power pump.	T-16	3,488	6	30	1,046	2,442
Beth'm power pump.	T-16	2,942	10	30	882	2,060
Blake pump	T-17	1,840	17	78.2	1,440	400
Dean pump	T-17	1,000		100	1,000	0
Platt pump, high lift	T-17	6,065	2	3.09	188	5,877
Ball engine	T-17	590	10	50	295	295
Worthington pump..	T-17	210	3	4.75	10	200
Platt pump, low lift.	T-17	1,375	2	6.20	85	1,290
BOILERS:						
66 x 16 fire tube....	T-17	1,400	10	38	535	865
66 x 18 fire tube....	T-17	1,650	17	78.4	1,350	300
78 x 20 fire tube....	T-17	2,400	2	6.2	150	2,250
78 x 20 fire tube....	T-17	2,450	1	3	75	2,375

ESTIMATED COST OF REPRODUCTION OF ENO RIVER PLANT—*Continued*

ITEM	Supporting Schedule, page	Estimated cost to build at present time	Age, years	DEPRECIATION Total per cent	DEPRECIATION Total amount	Cost to build less depreciation
Webster feed water heater	T-18	410	2	6.2	25	385
Coil feed water h'r..	T-18	150	17	78	117	33
Worth'n feed pump.	T-18	125	10	26.36	33	92
Worth'n feed pump.	T-18	100	2	4.3	4	96
Traps	T-18	75	2	9.5	7	68
Separators	T-18	500	2	4.3	22	478
24" Pelton wheel......	T-18	305	12	2.4	73	232
12" Pelton wheel......	T-18	70	8	14.4	10	60
3 K. W. generator.....	T-18	96	2	4.3	4	92
2 K. W. generator.....	T-18	75	8	20	15	60
Oil filters	T-18	40	5	16.7	7	33
Recording gauge	T-18	40	8	20	8	32
Stoves	T-18	60	5	43.94	26	34
Pyrene fire extinguishers	T-18	21	2	16.3	3	18
Badger fire extinguish'r	T-18	100	5	43.94	44	56
Electric light system...	T-19	150	8	14.4	22	128
Plumbing system	T-19	200	10	19	38	162
STEAM AND WATER PIPING:						
Old piping	T-19	1,724	10	26	455	1,269
New piping	T-19	6,024	2	4.3	259	5,765
Sum...........		$44,014			$11,574	$32,440
FILTERS:						
2 250,000 gallon units	T-19	5,500	21	75	4,120	1,380
3 350,000 gallon units	T-19	7,650	14	41	3,130	4,520
Sum...........		$13,150			$7,250	$5,900

ESTIMATED COST OF REPRODUCTION OF DISTRIBUTION RESERVOIR

ITEM	Estimated cost to build at present time	Age, years	DEPRECIATION Total per cent	DEPRECIATION Total Amount	Cost to build less depreciation
Distribution Reservoir:					
200 feet in diameter, 15 feet deep, capacity 3.5 million gallons to top					
1,200 cu. yds. rock excavation, at $1......	$ 1,200				
5,100 cu. yds. earth excavation, at 40 cents..	2,040				
Masonry wall, 2 feet at top, 5 feet at bottom 18 feet high; 1,470 cu. yds. at $8.40....	12,325				
700 lineal feet of fence, at 30 cents......	210				
Concrete steps	25				
Building, 15′ x 15′.....	200				
Total estimated cost of reproduction	$16,000	28	0.6	100	$15,900

ESTIMATED COST OF REPRODUCTION OF SUPPLY AND FORCE MAINS

(Supporting Schedule for Pipe Laying, T-20)

ITEM		Estimated Cost to build at present time	Depreciation Age, years	Depreciation Total per cent	Depreciation Total amount	Cost to build less deprecia-tion
12″ PIPE LINE, RIVER TO RESERVOIR:						
8,504 ft. pipe, @ $1.44..	$12,246					
Extra for rock, ...	935					
1 manhole	25					
10 air valves, @ $4	40					
1,926 lbs. spec., @ 3 cts.	58					
1 12″ gate, @ $12....	36					
13 valve boxes, @ $2.75	36					
1 12 x 4 Smith connect'n	20	$13,396	29	17.63	$2,360	$11,036
12″ LINE, RIVER TO RESERVOIR:						
8,526 ft. pipe, @ $1.44..	$12,277					
Extra for rock	935					
16 ft. 4″ pipe, @ 54 cts.	9					
2 air valves, @ $4.....	8					
1 12″ check valve......	60					
1,133 lbs. spec., @ 3 cts.	34					
1 4″ gate, ...	7					
4 12″ gates, @ $37....	148					
17 valve boxes, @ $2.75	47					
1 12 x 4 Smith Con's..	20	13,545	6	1.93	270	13,275
12″ LINE, RESERVOIR TO CITY:						
17,248 ft. pipe, @ $1.44	$24,837					
Extra for rock, ...	900					
12 ft. 4″ pipe, @ 54 cts.	6					
7 air valves, @ $4.....	28					
2,346 lbs. spec., @ 3 cts.	70					
1 4″ gate, ...	7					
1 6″ gate, ...	12					
4 12″ gates, @ $37....	148					
13 valve boxes, @ $2.75	36					
1 12 x 2 Smith con's..	8					
1 12 x 4 Smith con's..	20					
Extra for crossing	700	26,772	29	17.63	4,720	22,052

ESTIMATED COST OF REPRODUCTION OF SUPPLY AND FORCE MAINS—*Continued*

(Supporting Schedule for Pipe Laying, T-20)

ITEM		Estimated Cost to build at present time	Depreciation Age, years	Depreciation Total per cent	Depreciation Total Amount	Cost to build less depreciation
20″ LINE, RESERVOIR TO CITY:						
17,083 ft. pipe, @ $2.91	$49,711					
Extra for rock, ...	2,000					
Extra for crossing	1,300					
42 ft 4″, @ 54 cts.....	22					
110 ft. 12″, @ $1.44....	158					
8 air valves, @ $4.....	32					
4,451 lbs. spec., @ 3 cts.	133					
3 4″ gates, @ $7.50...	23					
1 6″ gate	12					
1 12″ gate, ...	37					
5 20″ gates, @ $125....	625					
19 valve boxes, @ $2.75	52					
1 12 x 4 Smith con's..	20	54,125	14	5.54	3,000	51,125
Total............		$107,838				$97,488

SUMMARY OF ESTIMATED COST OF REPRODUCTION OF DISTRIBUTION SYSTEM

ITEM	Supporting schedule, page	Estimated cost to build at present time	DEPRECIATION Age, years	Total per ct.	Total amount	Cost to build less depreciation
Cast iron pipe	T- 7	$154,278				
Gates	T- 7	5,484				
Specials	T- 7	3,132				
Valve boxes	T- 7	1,378				
Smith connections	T- 8	1,677				
Check valves, flange specials and manhole,......	T- 8	606				
Additional cost of laying mains under paving....	T- 9	25,688				
Sum..............		$192,243	14.8	7.9	$15,226	$177,017
Wrought iron pipe........	T- 9	$ 17,107				
Stops, lead connections, etc.	T- 9	994				
Curb boxes	T- 9	70				
Mueller connections	T-10	212				
Sum..............		$18,383	6.3	14.7	$2,716	$15,667
Hydrants	T-10	7,423	13.5	19.9	1,477	5,946
Meters	T-10	19,076	8.9	25.6	4,883	14,193
Meter boxes	T-11	2,343	8.5	20.3	476	1,867
Total estimated cost of reproduction of distribution system		$239,468	13.6	10.3	$24,778	$214,690

ESTIMATED COST OF REPRODUCTION OF DISTRIBUTION SYSTEM

CAST IRON PIPES

Size of pipe, inches	Supporting schedule page	Length in feet	Cost per foot	Total
4	T-21, 22	12,663	$ .48	$ 6,078
6	T-21, 22	122,292	.68	83,159
8	T-21, 22	18,833	.90	16,950
10	T-21, 22	3,254	1.18	3,840
12	T-21, 22	12,828	1.48	18,985
14	T-21, 22	3,443	1.82	6,266
16	T-21, 22	2,572	2.20	5,658
18	T-21, 22	252	2.58	650
20	T-21, 22	4,259	2.98	12,692
		$180,396		$154,278

GATE VALVES

Size of gates		Number		
4	T-24	71	$ 7.50	$ 533
6	T-24	198	12.00	2,376
8	T-24	37	18.50	685
10	T-24	12	26.50	318
12	T-24	22	37.00	814
14	T-24	7	48.00	336
16	T-24	3	65.00	195
18	T-24	1	102.00	102
20	T-24	1	125.00	125
		352		$5,484

SPECIALS

111,863 pounds	T-23	per pound, $0.028	3,132

VALVE BOXES

501	T-26	per box, $2.75	1,378

SMITH CONNECTIONS

Size of connection	Supporting schedule page	Number	Unit price	Total
20 x 12 Cross	T-25	1	$114.80	$ 115
20 x 12 Tee	T-25	2	69.30	138
20 x 8 "	T-25	4	46.80	187
20 x 6 "	T-25	5	39.20	196
20 x 4 "	T-25	1	34.20	34
14 x 12 "	T-25	2	57.70	115
12 x 8 "	T-25	4	34.40	137
12 x 6 "	T-25	5	26.80	134
12 x 4 "	T-25	1	21.60	22
12 x 2 "	T-25	1	8.00	8
10 x 6 "	T-25	2	23.60	47
10 x 4 "	T-25	1	18.40	18
8 x 8 "	T-25	1	28.80	29
8 x 6 "	T-25	2	21.00	42
8 x 4 "	T-25	8	15.70	126
8 x 2 "	T-25	1	8.00	8
6 x 6 "	T-25	4	18.90	76
6 x 4 "	T-25	8	13.60	109
6 x 2 "	T-25	15	8.00	120
4 x 2 "	T-25	2	8.00	16
				$1,677

CHECK VALVES

18	1	$200	200
12	1	54	54
8	2	24	48
			$302

MANHOLES

1 manhole, @ $25, ...$ 25

I BEAMS

3 8-inch I-beams, @ $7, ...$ 21

FLANGE SPECIALS

6,434 pounds flange specials, @ 4 cents......$258

ADDITIONAL COST OF LAYING MAINS UNDER PAVING

PAVING

Length in feet	Supporting schedule page	Description	Cost per foot of trench	Total
98,090	T-24	Macadam,	$ .16	$15,694
24,537	T-24	Bit. macadam,	.32	7,852
2,901	T-24	Brick on sand,	.33	957
902	T-24	Belgian block,	.58	523
1,140	T-24	Asphalt	.58	662
127,570				$25,688

WROUGHT IRON PIPE

	Length in feet		Total
¾	17,616	.14	$ 2,466
1	40,085	.15	6,013
1½	11,485	.19	2,182
2	29,299	.22	6,446
	98,485		$17,107

STOPS, LEAD CONNECTIONS AND CORPORATION COCKS

Size in inches	Supporting schedule, page	Description	Number	Unit price	Total
¾	T-26	Stops,	20	$ .30	$ 6
1	T-26	Stops,	93	.80	74
1½	T-26	Stops,	21	3.00	63
2	T-26	Stops,	52	5.00	260
¾	T-26	Lead connections	34	3.50	119
1	T-26	Lead connections,	68	4.50	306
¾	T-26	Corporation cocks,	33	.50	17
1	T-26	Corporation cocks,	180	.83	149
			501		$994

CURB BOXES

97 curb boxes, @ $0.72,......................$70

MUELLER CONNECTIONS

ITEM	Supporting schedule, page	Number	Unit price	Total
4-way,	T-25	22	$8.00	$176
3-way,	T-25	4	5.50	22
2-way,	T-25	4	3.50	14
				$212

HYDRANTS

ITEM	Supporting schedule, page	Number	Unit price	Total
Corey steamers	T-28	2	$26.50	$ 53
Darling steamers	T-28	19	30.50	580
4″ Glamorgan	T-28	110	28.25	3,108
6″ Glamorgan	T-28	7	28.50	200
Glamorgan steamers....	T-28	4	30.75	123
Glamorgan sprinklers..	T-28	5	23.50	117
4″ Columbian	T-28	2	26.50	53
6″ Columbian	T-28	3	28.95	87
4″ Smith	T-28	7	25.00	175
6″ Smith	T-28	6	27.00	162
Smith steamers........	T-28	18	27.00	486
4″ Coffin	T-28	83	26.50	2,200
4″ Matthews	T-28	3	26.50	79
				$7,423

METERS, SET, WITHOUT BOXES

ITEM	Supporting schedule, page	Number	Unit price	Total
½″ Hersey	T-29	1	$11.25	$ 11
⅝″ Hersey	T-29	146	11.25	1,642
⅝″ Crown	T-29	427	14.60	6,234
1″ Crown	T-29	8	31.50	252
1½″ Crown	T-29	2	49.00	98
2″ Crown	T-29	7	65.00	455
3″ Crown	T-29	1	132.80	133
⅝″ Empire	T-29	65	11.25	731
6″ Empire compound ...	T-29	1	428.65	429
⅝″ Neptune	T-29	14	11.25	158
⅝″ Lambert	T-29	711	11.25	7,999
1″ Lambert	T-29	18	19.00	342
1½″ Lambert	T-29	1	31.00	31
2″ Lambert	T-29	8	50.00	400
¾″ Worthington	T-29	1	8.65	9
1″ Worthington	T-29	4	15.40	62
⅝″ Gamon	T-29	9	10.00	90
				$19,076

METER BOXES

Number	Description	Unit price	Total
916	Kerr's Foundry	$ .50	$ 458
293	Glamorgan	3.80	1,112
189	Griffin Foundry	2.00	378
9	Cooks Machine works	2.00	18
21	Brick manholes, iron covers	17.00	357
2	Brick manholes, wood covers	10.00	20
1,430			$2,343

ESTIMATED COST OF REPRODUCTION OF FIRE PUMP AND RESERVOIR AT DUKE'S FACTORY

Reservoir:		
14 feet deep, 50 feet in diameter, capacity, 206,000 gallons.		
Excavation, 1,100 cubic yards, @ 40 cents........	$ 440	
Masonry, 180 cubic yards, @ $8.00...............	1,440	$1,880
Pump:		
1 3.6-million gallon, horizontal compound duplex pump, against 125 pounds, 183 water horse power, @ $30.00	$5,490	
Erection	300	
Foundations	150	$5,940
Total estimated cost of reproduction.............		$7,820

ESTIMATED COST OF REPRODUCTION OF TELEPHONE LINE

LENGTH, 5½ MILES

290 poles, @ $2.00........................	$580.00
290 holes, @ $0.15	43.50
Setting poles, @ 30 cents..................	87.00
Insulators and brackets	10.00
No. 12 galvanized wire	41.40
Erecting wire	54.00
Total estimated cost of reproduction......	$815.90

ESTIMATED ORIGINAL COST OF LAND, WATER RIGHTS AND EASEMENTS

33 acres land alone, at plant	$1,850
10 acres at Cole's Mill, including flowage rights	3,500
For reservoir	500
Water rights, including damages, etc.,	5,150
Easements on pipe lines	3,000
Total estimated actual cost of land, water rights and easements	$14,000

ESTIMATED COST OF REPRODUCTION, ENO RIVER PLANT

Description		Cost to reproduce new	Depreciation Age, yrs.	Depreciation Total per ct.	Depreciation Total amt.	Cost to Build less depreciation
POWER DAM:						
Rock excavation, 1,200 cu. yds., @ $1	$1,200					
Masonry walls, 148 cu. yds., @ $8	1,185					
Rock fill, 326 cu. yds., @ 75c.	245					
Timber, oak, 8,000 BM, @ $50	400	$3,030	28	6.6	$200	$2,830
TAIL RACE:						
Rock excavation, 90 cu. yds., @ $1		90	28	0		90
NANCY RHODES POND:						
6 million gals. cap.						
Dam: Masonry walls, 353 cu. yds., @ $8............	$2,824					
Earth embankment, 1,865 cu. yds., @ 40 cts.	746					
Timber, oak, 4,500 BM. @ $50	225					
Clearing site	50					
Screens and foot bridge.....	100					
	$3,945					
ROAD CROSSING ON EMB:						
Masonry, 57 cu. yds., @ $8...	$ 456					
Earth embankment, 410 cu. yds., @ 40 cts.............	164					
Timber, 800 BM, @ $50......	40					
	$ 660					
CANAL WEST SIDE OF POND:						
Masonry, 66 cu. yds., concrete, @ $8	$ 528					
Rock excavation, 1,011 cu. yds., @ $1	1,011					
Earth excavation, 530 cu. yds., @ 30 cts.	160					
CANAL, EAST SIDE:						
Rock excavation, 196 cu. yds., @ $1	196					
Earth excavation, 196 cu. yds., @ 30 cts.	60					
	$1,955	$6,560	28	39	$2,560	$4,000

ESTIMATED COST OF REPRODUCTION OF ENO RIVER PLANT—*Continued*

Description		Cost to reproduce new	Depreciation Age, yrs.	Depreciation Total per ct.	Depreciation Total amt.	Cost to Build less depreciation
STRUCTURES: BUILDINGS:						
Water power house: Superstructure, frame, 22,300 cu. ft., @ 6 cts., 1,488 sq. ft.	$1,338					
Foundations: Rock excavation, 367 cu. yds., @ $1.50	550					
Earth excavation, 40 cu. yds. @ 30 cts.	12					
Masonry, 250 cu. yds.; @ $8..	2,000	$3,900	18	42.35	$1,652	$2,248
Filter house: Superstructure frame, 71,000 cu. ft., @ 6 cts., 3,850 sq. ft.....	4,260					
Foundations: Earth excavation, 425 cu. yds., @ 30c...	127					
Masonry concrete, 72 cu. yds., @ $8	576	$4,963	16	49.57	$2,460	$2,503
Pumping station building: Superstructure, galvanized iron on frame, 100,000 cu. ft., @ 5 cts.	$5,000					
Foundations: Rock excavation, 100 cu. yds., @ $1...	100					
Earth excavation, 750 cu. yds., @ 30 cts.	225					
Masonry foundation and walls exclusive of pump foundations, 227 cu. yds., @ $8	$1,816	$7,141	10	18.93	$1,351	$5,790
1 dwelling house		$1,200	23	34.30	$ 411	$ 789
1 house		500	10	19	95	405
1 alum shed		100	2	3	3	97
1 office building		50	2	3	2	48
1 oil house		150	2	3	5	145
1 chemical house		100	2	3	3	97
King's house		1,600	3	2.61	42	1,558

ESTIMATED COST OF REPRODUCTION OF ENO RIVER PLANT—*Continued*

Description		Cost to reproduce new	Depreciation Age yrs.	Depreciation Total per ct.	Depreciation Total amt.	Cost to Build less depreciation
EQUIPMENT:						
Water Power:						
1-35″ Leffel vertical water wheel with flumes, no governor	$1,365					
Head gates, trash racks, hauling and erection	$1,100	$2,465	15	32.5	$ 800	$1,665
1-15″ Holyoke vertical wheel and pump,	$ 775					
Hauling and erection	$ 50	$ 825	9	16.6	$ 137	$ 688
1-9⅛ x 18 Bethlehem power pump, belt driven, capacity 1.5 mil. gals.,	$2,253					
Hauling and erection	425					
Belt	274					
Oiling system	40	$2,992	10	60	$1,792	$1,200
Steam pumping equipment:						
1-14 x 36 Corliss engine, driving 2 power pumps	$1,237					
Bearings and shafting	265					
Erection	235					
Foundation	$ 320	$2,057	9	30	$ 617	$1,440
1-10 x 20 duplex single acting Bethlehem power pump, capacity 2-¼ million gallons	$2,428					
Erection	400					
Foundations	120					
Belt	400					
Oil system	40					
Air chambers	100	$3,488	6	30	$1,046	$2,442
1 9⅛ x 18 Duplex single acting Bethlehem power pump, capacity 1.5 mil. gals.	$2,207					
Erection and hauling	350					
Foundations	96					
Belt	249					
Oil system	40	$2,942	10	30	$ 882	$2,060

ESTIMATED COST OF REPRODUCTION OF ENO RIVER PLANT—*Continued*

Description		Cost to reproduce new	Depreciation Age, yrs.	Depreciation Total per ct.	Depreciation Total amt.	Cost to Build less depreciation
1 Blake, horizontal compound, 14 x 20 x 11 duplex, capacity 1.5 million gals.	$1,500					
Erection	300					
Foundations	40	$1,840	17	78.2	$1,440	$ 400
Dean pump		$1,000		100.	$1,000	0
1 Platt horizontal tandem, compound duplex, 16 x 26 x 16 x 24; head 300 feet, capacity 3 MGD; duty, 50 million, with surface condenser circulating and air pump	$5,385					
Erection	200					
Foundations	480	$6,065	2	3.09	$ 188	$5,877
1 Ball single engine, driving Worthington centrifugal pump	500					
Erection	50					
Foundations	40	$590	10	50	$295	$295
1 8″ Class D Worthington volute pump	$ 150					
Erection	40					
Foundation	20	$210	3	4.75	$10	$200
1 14″ Platt Centrifugal pump, direct connected to 1 8 x 9 Fleming engine, capacity 5 MGD. Head 35 ft., erected	$1,375	$1,375	2	6.2	$85	$1,290
BOILERS:						
1 66 x 16, 100 H. P., F. T. cost set,		$1,400	10	38.0	$ 535	$ 865
1 66 x 16, 125 H. P., F. T.		1,650	17	78.4	1,350	300
1 78 x 20, 200 H. P., F. T.		2,400	2	6.2	150	2,250
1 78 x 20, 200 H. P., F. T. with steel casing		2,450	1	3.0	75	2,375

ESTIMATED COST OF REPRODUCTION OF ENO RIVER PLANT—*Continued*

Description		Cost to reproduce new	Depreciation Age yrs.	Depreciation Total per ct.	Depreciation Total amt.	Cost to Build less deprecia-tion.
1 Webster vacuum feed water heater, 400 H. P., with 10″ separator, 6″ gate valve, and 1″ grease trap	$ 360					
Erection	50	$410	2	6.2	$25	$385
1 coil feed water heater.....	150	$150	17	78	$117	$33
1 6 x 4 x 6 Worthington boiler feed pump, erected		$125	10	26.36	$33	$92
1 5¼ x 3½ x 5 Worthington boiler feed pump, erected		$100	2	4.3	4	$96
3 ½″ Anderson traps, @ $25		75	2	9.5	7	68
1 12″ steam separator........		150	2	4.3	7	143
1 10″ steam separator, @ $1..		100	2	4.3	4	96
1 3″ separator receiver......		100	2	4.3	4	96
1 5″ separator receiver......		150	2	4.3	7	143
1 24″ Pelton wheel,.........	$230					
Hauling and setting	40					
Foundation	35	$305	12	24	$73	$232
1 12″ Pelton wheel	50					
Setting	20	$70	8	14.4	$10	$60
1 3 KW G. E., D. C. generator		96	2	4.3	4	92
1 2 KW Holtzer Cabot Generator		75	8	20	15	60
1 5 gallon oil filter..........		25	5	16.7	4	21
1 3 gallon oil filter..........		15	5	16.7	3	12
1 Bristol recording pressure gauge		40	8	20	8	32
3 stoves, @ $20		60	5	43.94	26	34
3 Pyrene fire extinguishers, @ $7		21	2	16.3	3	18
4 Badger fire extinguishers, @ $25		100	5	43.94	44	56

ESTIMATED COST OF REPRODUCTION OF ENO RIVER PLANT—*Continued*

Description		Cost to reproduce new	Depreciation Age, yrs.	Depreciation Total per ct.	Depreciation Total amt.	Cost to Build less depreciation
Electric light system, including outside lines..........		$150	8	14.4	22	$128
Plumbing system		200	10	19.0	38	162
Old steam and water piping and fittings, erected		1,724	10	26	455	1,269
New steam and water piping and fittings, all installed in 1913, erected		6,024	2	4.3	259	5,765
FILTER PLANT:						
3 250,000 gallon units, Warren Gravity wood tub filters, erected in place with most of the piping,..	$4,500					
Extra piping	500					
Part of the erection done by company	500	$5,500	21	75	$4,120	$1,380
3 350,000 gallons units, same type, erected with part of piping	$6,150					
Extra piping	750					
Part of erection done by company	750	$7,650	14	41	$3,130	$4,520
Above filters include wooden coagulating basin and wooden pure well.						

ESTIMATED COST OF LAYING PIPE IN FORCE MAINS

	Size of pipe, inches 12 in.	20 in.
Width of trench at top, feet	3.0	4.0
Width of trench at bottom, feet	2.5	3.5
Depth of trench in feet	3.5	4.2
Cubic yards per foot	0.36	0.58
Weight of pipe per ft. class B, × 1.5% for overweight	83.4	177.6
Weight of lead in one joint, pounds	20	40
Cost of lead joint every 12 ft., in cts., per foot of pipe	8.75	17.50

COST PER FOOT:

Excavation		$ .13	$ .209
Lead		.09	.175
Other costs		.10	.18
Cost of laying		$ .32	$ .564
Hauling		.042	.088
Cost of pipe per ton ... For 12″	$25.75		
Cost of pipe per ton ... For 20″	25.50		
Cost per foot		$1.074	$2,264
Total		$1.436	$2.916
Use		$1.44	$2.91

ESTIMATED COST OF LAYING CAST IRON PIPE IN DISTRIBUTION SYSTEM

	SIZE OF PIPE, IN INCHES								
	4	6	8	10	12	14	16	18	20
Width of trench at at top, feet....	2.5	2.5	2.5	2.7	3.0	3.2	3.5	3.7	4.0
Width of trench at bottom, feet ..	2.0	2.0	2.0	2.2	2.5	2.7	3.0	3.2	3.5
Depth of trench in feet	2.8	3.0	3.2	3.3	3.5	3.7	3.8	4.0	4.2
Cubic yards per ft.	0.23	0.25	0.27	0.31	0.36	0.41	0.46	0.52	0.58
Weight of pipe per ft., Class B, × 1.5% overweight	22.	33.8	48.2	64.7	83.4	104.	126.9	152.2	177.6
Lead in joints, lbs.	7.	10.	13.	16.	20.	24.	32.	35.	40.
Cost of lead, joints, 11 ft., 5¼ cts., per lb., in cents per foot of pipe	3.5	5.0	6.5	8.0	10.0	12.	16.	17.5	20.
Cost per foot excavation, @ 40 cts.	0.090	0.100	0.108	0.124	0.144	0.164	0.184	0.208	0.232
Lead	0.035	0.050	0.065	0.080	0.100	0.120	0.160	0.175	0.200
Other costs	0.03	0.05	0.06	0.08	0.10	0.12	0.14	0.16	0.18
Cost of Laying....	0.155	0.20	0.233	0.284	0.344	0.404	0.484	0.543	0.612
Hauling	0.01	0.02	0.025	0.03	0.04	0.05	0.06	0.07	0.08
Pipe per ton	26.50	26.00	26.00	26.00	25.75	25.75	25.75	25.50	25.50
Cents per foot of pipe	0.292	0.440	0.626	0.842	1.07	1.34	1.63	1.94	2.26
Sum	0.46	0.66	0.88	1.156	1.45	1.79	2.17	2.55	2.95
Add for city conditions and crossings	0.02	0.02	0.02	0.025	0.03	0.03	0.03	0.03	0.03
Total	0.48	0.68	0.90	1.18	1.48	1.82	2.20	2.58	2.98

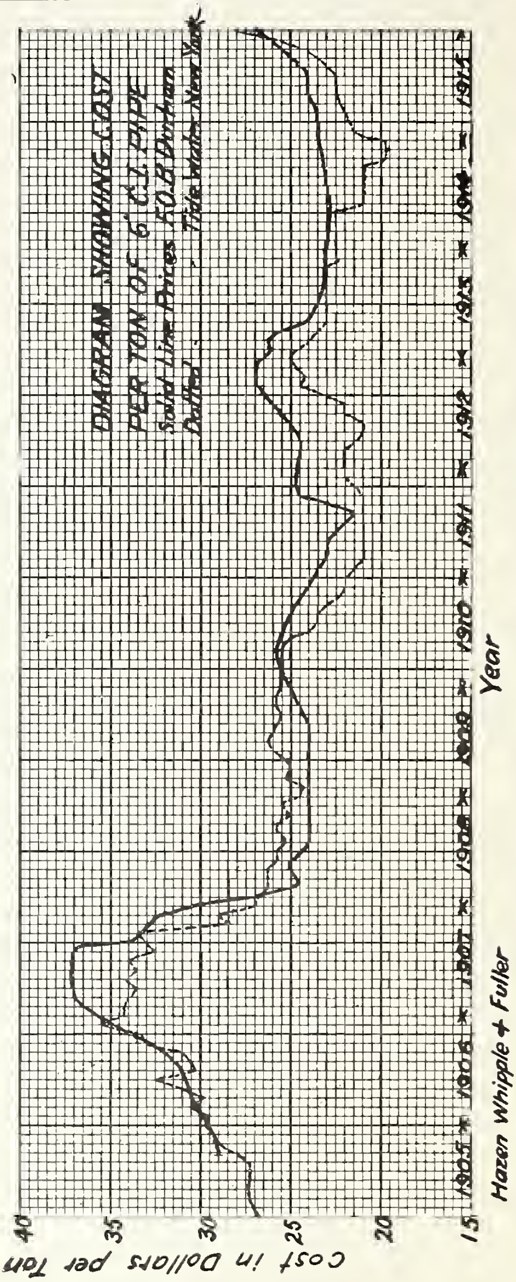
DIAGRAM SHOWING COST
PER TON OF 6" C.I. PIPE
Solid Line Prices F.O.B. Durham
Dotted " Tide Water New York
Year
1905
1906
1907
1908
1909
1910
1911
1912
1913
1914
1915
Hazen Whipple + Fuller
40
35
30
25
20
15
Cost in Dollars per Ton

ACTUAL PRICES PAID BY THE DURHAM WATER COMPANY FOR SPECIALS AND LEAD DURING THE LAST TEN YEARS

Date		Prices paid cents per pound Specials	Lead	Average price per pound per year for Specials	Lead
1906	April	2.9	5.25		
	June	2.9			
	September	3.25	6.3		
	November		7.0	3.2	6.18
1907	March	3.25	7.25		
	May	3.25	7.25		
	July	3.25	7.5		
	August	3.25			
	October		6.50		
	November	3.25	6.75		
	December		5.25	3.25	6.75
1908	March	2.9	4.75		
	April	2.8	4.75		
	May	2.75	4.95		
	September	2.75	5.25		
	December		5.00	2.80	4.94
1909	April	2.75	5.00		
	September	2.75		2.75	5.00
1910	April	2.75	5.00		
	May	2.75			
	June		5.00	2.75	5.00
1911	April	2.75	5.10		
	May		4.90		
	August	2.75			
	October	2.75	5.25	2.75	5.08
1912	April	2.75			
	July	2.50	5.50		
	September	2.75	5.50		
	November	2.75	5.75	2.69	5.50
1913	January	2.65	5.50		
	February	2.75			
	March	2.75			
	May	2.65		2.70	5.50
1914	March		5.00		
	April	2.75	5.00		
	October	2.75	4.75		
	December		4.75	2.75	4.87
1915	January	2.75	5.00		
	July	2.75	7.50		
	August	2.75	6.5		
	September	2.75	6.0	2.75	6.25
	Average for ten years			2.82	5.507

ACTUAL AVERAGE COST TO THE WATER COMPANY OF GATES BOUGHT DURING THE LAST 10 YEARS, WITH ESTIMTED COST OF SETTING.

	SIZE, IN INCHES								
	4	6	8	10	12	14	16	18	20
Average cost....	$7.00	$11.00	$17.00	$25.00	$35.00	$45.00	$60.00	$ 95.00	$115.00
Setting ..	.50	1.00	1.50	1.50	2.00	3.00	5.00	7.00	10.00
Total	$7.50	$12.00	$18.50	$26.50	$37.00	$48.00	$65.00	$102.00	$125.00

ESTIMATED COST OF CUTTING AND REPLACING PAVEMENT

BASED ON A WIDTH OF CUTTING OF 3 FEET

For brick on sand........	@ $1.00 per sq. yd.	$ .33 per ft. of trench
For asphalt on concrete..	@ $1.75 per sq. yd.	$ .58 per ft. of trench
For macadam	@ $ .50 per sq. yd.	$ .16 per ft. of trench
For bitumen macadam....	@ $1.00 per sq. yd.	$ .32 per ft. of trench
For stone block..........	@ $1.75 per sq. yd.	$ .58 per ft. of trench

ESTIMATED COST OF REPLACING SMITH CONNECTIONS WITH AN EQUIVALENT REGULAR SPECIAL AND GATE, 2″ CONNECTIONS FIGURED AS TAPS

Size	Cost
20 x 12 cross	$114.80
20 x 12 tee	69.30
20 x 8 tee	46.80
20 x 6 tee	39.20
20 x 4 tee	34.20
14 x 12 tee	57.70
12 x 8 tee	34.40
12 x 6 tee	26.80
12 x 4 tee	21.60
12 x 2 tee	8.00
10 x 6 tee	23.60
10 x 4 tee	18.40
8 x 8 tee	28.80
8 x 6 tee	21.00
8 x 4 tee	15.70
8 x 2 tee	8.00
6 x 6 tee	18.90
6 x 4 tee	13.60
6 x 2 tee	8.00
4 x 2 tee	8.00

ESTIMATED COST OF REPLACING MUELLER CONNECTIONS WITH AN EQUIVALENT TAP AND STOP

For 4-way, allow one 2″ tap, @ $3.00 and one 2″ stop @ $5.00..	$8.00
For 3-way, allow one 1½″ tap @ $2.50 and one 1½″ stop @ $3.00	5.50
For 2-way, allow, one 1¼″ tap @ $2.00, and one 1¼″ stop @ 1.50	3.50

ACTUAL COST TO WATER COMPANY OF VARIOUS APPURTENANCES TO THE DISTRIBUTION SYSTEM WITH ESTIMATED COST OF SETTING

Glamorgan standard valve boxes	\$2.30
Estimated cost of setting	.45
Total	\$2.75

Curb Boxes	\$ .60
Estimated cost of setting	.12
	\$ .72

STOPS:

¾″	1″	1½″	2″
\$ .30	\$ .80	\$3.00	\$5.00

Lead connections:

¾″ connection, without cock	\$2.00
Estimated cost of setting	1.50
Total	\$3.50

1″ connection, without cocks	\$3.00
Estimated cost of setting	1.50
Total	\$4.50

Corporation cocks: Listed separately from lead connections:

¾″	\$ .50
1″	.83

TOTAL WEIGHT OF PIPE IN SYSTEM

DISTRIBUTING SYSTEM AND PIPING AROUND PUMPING STATION

Size, in inches	Length in feet	Weight in pounds per foot	Total weight in pounds
4	12,663	21.7	274,787
6	122,292	33.3	4,072,324
8	18,833	47.5	894,567
10	3,254	63.8	207,605
12	12,828	82.1	1,053.179
14	3,443	102.5	352,907
16	2,572	125.0	321,500
18	252	150.0	37,800
20	4,259	175.0	745,325
	180,396		7,959,994

Weight of specials in distribution system.......	111,863 lbs.	
Add for Smith connections	28,676	
		140,539
Per cent of specials	1.77	

FORCE AND SUPPLY MAINS

Size in inches	Length in feet	Weight in lbs. per foot	Total weight in pounds	
12″	34,278	82.1	2,814,224	
20″	17,083	175.0	2,989,525	
Tootal....................				5,803,749

Weight of specials in force and supply mains......	9,856 lbs.	
Add for Smith connections	2,365	12,221
Total weight of pipe in system................		13,916,503
		6,958 tons

ACTUAL PRICES PAID BY THE DURHAM WATER COMPANY FOR HYDRANTS

Make	Size and type	Cost of hydrant	Setting	Total
Glamorgan	4″	$24.75	$3.50	$28.25
	6″	25.00	3.50	28.50
	Steamer	27.25	3.50	30.75
	Sprinkler	20.00	3.50	23.50
Smith	4″	21.50	3.50	25.00
	6″	23.50	3.50	27.00
	Steamer	23.50	3.50	27.00
Columbian	4″	23.00	3.50	26.50
	6″	25.45	3.50	28.95
Darling	Steamer	27.00	3.50	30.50
Corey	4″	23.00	3.50	26.50
Corey	Steamer	23.00	3.50	26.50
Coffin	4″	23.00	3.50	26.50
Matthews	4″	23.00	3.50	26.50

ESTIMATED COST OF REPRODUCTION OF METERS AND SETTING

Size of meter	Make	Meter	Coup-ling	Wiper	Setting	Allowed for dis-counts etc.	Net repro-duction in place
⅝"	Lambert	$ 8.50	$ .40		$ 3.00	$ .65	$ 11.25
1 "	Lambert	16.50	.80		3.25	1.55	19.00
1½"	Lambert	30.50			3.50	3.00	31.00
2 "	Lambert	51.00			4.00	5.00	50.00
⅝"	Gamon	7.25	.50		3.00	.75	10.00
⅝"	Empire	10.00	.40	.40	3.00	2.55	11.25
6 "	Empire Comp.	408.65			20.00		428.65
⅝"	Crown	12.00	.40	.40	3.00	1.20	14.60
1 "	Crown	30.00	.80	.40	3.25	2.95	31.50
1½"	Crown	50.00		.40	3.50	4.90	49.00
2 "	Crown	65.00		.40	4.00	4.40	65.00
3 "	Crown	123.40	2.00	.40	7.00		132.80
⅝"	Hersey	9.40		.50	3.00	1.65	11.25
¾"	Worthington	7.25			3.00	.60	8.65
1 "	Worthington	13.50			3.25	1.35	15.40
⅝"	Neptune	8.00	.40	.50	3.00	.65	11.25

TABLE SHOWING POPULATION AND EARNINGS

Year	Population of City of Durham	Population of Durham Township	Estimated population of district served by Durham Water Company	Total earnings per capita	Total earnings
1890	5,485	10,420	7,500	$1.15	$ 8,620
1900	6,679	19,055	10,000	2.41	24,145
1910	18,241	27,606	24,000	2.52	60,550
1915			31,000	3.04	94,496
1920			38,000*	3.30*	*125,000

*Estimated.

EARNINGS AND EXPENSES, 1900 TO 1915 INC.

	Gross earnings	Operating expenses	Net earnings
1900	$24,145	$ 9,147	$14,998
1901	28,697	12,652	16,045
1902	32,924	10,277	22,647
1903	36,942	11,418	25,524
1904	39,295	13,673	25,532
1905	42,530	20,524	22,006
1906	45,828	17,951	27,877
1907	50,568	23,038	27,530
1908	54,828	23,369	31,459
1909	55,177	24,852	30,325
1910	60,556	27,825	32,731
1911	63,439	32,808	30,631
1912	73,986	34,339	39,647
1913	80,501	42,658	37,843
1914	89,381	49,333*	40,048
1915	94,496	45,649	48,847

* These operating expenses are revised to exclude charges which were obviously for new construction, extraordinary legal services, and other expenses, which were abnormal for this year.

NOTE:—The operating expenses, except those for 1914, are those carried by the company and include some amounts which should properly be charged to construction.

MAINTAINABLE NET INCOME, TOGETHER WITH ESTIMATED COST OF OPERATION AND EARNINGS FOR THE NEXT FIVE YEARS

Year	1915	1916	1917	1918	1919	1920
Gross earnings	$94,175	$100,000	$106,250	$112,500	$119,000	$125,500
Operating expenses	50,825	55,500	59,500	63,500	67,750	72,000
Net revenue	43,350	44,500	46,750	49,000	51,250	53,500
Estimated total construction during the year		$60,000	$30,000	$10,000	$10,000	$10,000
Total additional investment		60,000	90,000	100,000	110,000	120,000
Interest and depreciation on above additional investments 6½%		3,900	5,850	6,500	7,150	7,800
Net income, less interest on additional investment		40,600	40,900	42,500	44,100	45,700

Average net earnings for five-year period....................$ 42,760
An amount sufficient to return 7% on........................ 611,000

This will allow 6% interest to be paid after 1% has been set aside for depreciation.

COMPUTATION FOR GOING VALUE

EARNINGS, PRESENT PLANT:

In the following table, under Present Plant, in the second column, is given the estimated rate of gross revenue of the present plant during the next five years if it should continue in business. The figures have been obtained by a consideration of the gross earnings for some years back.

EXPENSES, PRESENT PLANT:

The third column under the same heading contains a similar estimate of the probable rate of expense of the present plant. In making up these figures due weight has been given to the fact that on the company's books have been made charges against expenses which should properly have been made to construction, and also to the fact that until 1912 part of the pumping was done by water power.

EARNINGS, NEW PLANT:

The following assumptions have been made as to the earnings which would be secured by the new plant. Public hydrant rentals will be obtained at once and will be the same as the present plant at all times. It is assumed that the remaining business will be secured in accordance with the following schedule:

At the end of	Percentage of estimated earnings of the present plant, exclusive of hydrant rentals
Six months	40%
One year	60%
Two years	80%
Three years	90%
Four years	97%
Five years	100%

The total earnings of the new plant will be the sum of the public hydrant rentals and the above proportions of the remaining earnings.

OPERATING EXPENSES, NEW PLANT:

It is assumed that at the beginning the operating expenses of the new plant will be 75% of those of the present plant during the same period of time. The remaining 25% of the operating expenses is assumed in proportion to the rate at which the business develops; that is, that is,

40% at the end of six months
60% at the end of one year
and so on.

TOTAL GOING VALUE:

On the above assumptions the probable profits of the present plant, and of a new plant for the next five years, have been estimated. The amount each year by which the profits of the present plant would exceed those of the new plant have been determined, and the sum of these amounts reduced to present worth represents the Total Going Value.

The tables are as follows:

COMPUTATION OF GOING VALUE

COMPARISON OF EARNINGS OF NEW AND PRESENT PLANTS

PRESENT PLANT

Time,	Approximate estimated rate of gross revenue	Approximate estimated rate of expenses	Approximate estimated rate of net earnings
1916 Jan. 1	$ 97,000	$53,500	$43,500
1916 July 1	100,000	55,500	44,500
1917 Jan. 1	103,000	57,500	45,500
1918 Jan. 1	109,300	61,500	47,800
1919 Jan. 1	115,800	65,500	50,300
1920 Jan. 1	122,200	69,750	52,450
1921 Jan. 1	128,800	73,750	55,050

NEW PLANT

Time,	Estimated rate of public hydrant rentals	Estimated rate of gross earnings of present plant less hydrant rental			Estimated earnings, exclusive of hydrant rentals	Approximate estimated rate of gross revenue, new plant
1916 Jan. 1	$10,650	$ 86,350	@	0%		$ 10,650
1916 July 1	10,850	89,150	@	40%	$ 35,650	46,500
1917 Jan. 1	11,050	91,950	@	60%	55,150	66,200
1918 Jan. 1	11,450	97,850	@	80%	78,300	89,750
1919 Jan. 1	11,850	103,950	@	90%	93,550	105,400
1920 Jan. 1	12,250	109,950	@	97%	106,650	118,900
1921 Jan. 1	12,650	116,150	@	100%	116,150	128,800

ESTIMATED RATE OF EXPENSES FOR NEW PLANT

Time	75% expense rate of present plant	25% expense rate of present plant		Portion of the 25% assumed to be required for new plant		Estimated total rate of expense for new plant	Estimated rate of net earnings new plant
1916 Jan. 1	$40,100	$13,400	@	0%		$40,100	—$29,450*
1916 July 1	41,600	13,900	@	40%	$ 5,550	47,150	—650*
1917 Jan. 1	43,100	14,400	@	60%	8,650	51,750	14,450
1918 Jan. 1	46,100	15,400	@	80%		58,400	31,350
1919 Jan. 1	49,100	16,400	@	90%	14,750	63,850	41,550
1920 Jan. 1	52,300	17,450	@	97%	16,950	69,250	49,650
1921 Jan. 1	55,300	18,450	@	100%	18,450	73,750	55,050

* Deficit.

EXCESS OF NET EARNINGS OF PRESENT PLANT OVER THOSE OF NEW PLANT

Time	Rate of excess	During	Average rate	Total amount	Discount factor at 6%	Present worth
1916 Jan. 1	$72,950	1916*	$59,050	$29,525	0.9855	$29,100
1916 July 1	45,150	1916†	38,100	19,050	0.9573	18,225
1917 Jan. 1	31,050	1917	23,750	23,750	0.9163	21,750
1918 Jan. 1	16,450	1918	12,600	12,600	0.8645	10,900
1919 Jan. 1	8,750	1919	5,775	5,775	0.8155	4,700
1920 Jan. 1	2,800	1920	1,400	1,400	0.7694	1,075

Going Value $85,750

*First half of year.
†Second half of year.

TABLE SHOWING RATE AT WHICH BUSINESS WAS ACQUIRED IN NEW ORLEANS, TOGETHER WITH RATE AT WHICH IT IS ASSUMED IT WOULD BE ACQUIRED IN DURHAM

	NEW ORLEANS			
	Number of services connected at end of year	Approximate number of premises connected	Per ct. of premises connected to total number of premises in city	Per ct. of total revenue exclusive of hydrant rentals assumed for Durham
At start	2,000	2,000	2.5	40
First year	12,700	15,800	20.5	60
Second year	22,600	26,000	33.5	80
Third year	29,068	36,000	46.5	90
Fourth year	33,959	46,000	59.0	97
Fifth year	40,883	55,000	70.5	100
Sixth year	47,653*	64,000	82.0	

*Total number of premises in city, 78,000

ESTIMATED VALUE OF THE FRANCHISE, ON THE BASIS THAT $579,000 IS THE VALUE OF THE PLANT, EXCLUSIVE OF THE FRANCHISE VALUE

Assume value of plant January 1, 1916..........		$579,000
Assume that $60,000 construction work is done during the first year: Add one-half of $60,000..		30,000
Average value of plant during 1916.............		$609,000
Estimated net income during first year..........	$44,500	
Interest and depreciation charge, 6½% of $609,000	39,585	
Profit during first year.........................	$ 4,915	
Remainder of Construction first year..........		$ 30,000
Plant value at end of 1916......................		$639,000
Assume $30,000 construction during second year, and add one-half of this......................		$15,000
Average plant value during 1917................		$654,000
Estimated income during second year	$46,750	
Interest and depreciation charge, 6½ % of $654,000	42,510	
Profit during second year	$ 4,240	
Remainder of Construction second year		$ 15,000
Total value at end of 1917.......................		$669,000
Assume $2,500 construction in first three months 1918, and add one-half of this................		$ 1,250
Average value, first three months of 1918........		$670,250
Estimated income, first three months of 1918....	$12,000	
Interest and depreciation at 6½% per year on $670,250	10,892	
Profit during first three months of 1918..........	$ 1,108	

SUMMARY

Year	Net profits	Discount factor @ 6%	Present worth
1916	$4,915	0.9713	$4,744
1917	4,240	0.9163	3,885
First three month of 1918	1,108	0.8836	979
Total present worth of profits, or franchise value			$9,638

RELATION EXISTING BETWEEN "FRANCHISE VALUE" AND THE TOTAL VALUE OF THE PLANT, EXCLUDING "FRANCHISE VALUE"

If the total value of the plant were reduced, the interest charges in the above table would be reduced by 6½% of this reduction, and the profits increased accordingly. Therefore the relation between the "Franchise Value" and the Total Value is as follows:

INCREASE IN FRANCHISE VALUE IN PER CENT OF DECREASE OF TOTAL VALUE, EXCLUSIVE OF FRANCHISE

First year	6½%	Discount factor, 0.9713	6.313%
Second year	6½%	Discount factor, 0.9163	5.956%
First three months, ¼ of 6½%		Discount factor, 0.8836	1.436%
Total			13.705%

This means that if the total value were reduced say $100,000 that the franchise value will be greater than above given by 13.705% of $100,000, or $13,705.

ESTIMATED COST OF REPRODUCTION LESS DEPRECIATION OF THAT PORTION OF THE COMPANY'S PLANT WHICH WOULD BE USED AT ONCE IF THE FLAT RIVER SUPPLY WERE CONNECTED TO PRESENT SYSTEM

Distribution Reservoir on Huckleberry Hill......		$ 15,900
Supply mains from reservoir to city.............		73,175
Distribution System		206,690
Sum...................................		$295,765
Engineering and contingencies @ 12½%........		36,971
		$332,736
Interest at 6%		19,964
		$352,700
Land and easements necessary for above structures	$2,500	
5% overhead	125	
	$2,625	
12% interest	315	$ 2,940
		$355,640
Going Value		85,750
Franchise Value		9,638
		$451,028
Inventory of material and supplies on hand (from company's inventory)		13,986
Total....................................		$465,614

A further portion of the company's plant could be made of use to the city by removing it from its present location and setting it up at the city's plant. The following estimate is on the basis of the cost of reproduction less depreciation less a further amount for removing and transporting to the new site.

Items at Eno River plant, chiefly pumps and boilers........	$ 18,169
12" force mains from river to reservoir....................	10,415
Adding these to the above sum=.........................	$493,598
The remaining portion of the compnay's plant not included in above schedule would have a value as scrap or for other purposes than water supply estimated to be......	10,325
Total..	$503,923

Memoranda Regarding Professional Work Done by Hazen, Whipple & Fuller During the Last Twenty Years

Hazen, Whipple & Fuller were unknown personally to anyone connected with the Durham Water Company. They were engaged because of their high standing and experience and because they had enjoyed the confidence of the City of Durham and had been employed by it. Asked for a statement of work done by the firm, they submitted the following memorandum. The bulk of these items covers work done by municipalities.

ADVICE REGARDING WATER SUPPLIES, INCLUDING REPORTS AND RECOMMENDATIONS FOR IMPROVEMENTS AND INCREASE IN SUPPLIES, RECOMMENDATIONS AS TO FILTRATION, PLANS AND SPECIFICATIONS, SUPERVISION OF CONSTRUCTION OF WORK AND OPERATION OF PLANTS

Albany, N. Y.
Auburn, N. Y.
Augusta, Me.
Austin, Tex.
Baltimore, Md.
Bangor, Me.
Battle Creek, Mich.
Bethlehem, Pa.
Boston, Mass.
Brandon, Man.
Brisbane, Queensland
Burlington, N. J.
Burlington, Vt.
Charleston, S. C.
Chester, Pa.
Cleveland, Ohio
Columbia, S. C.
Columbus, Ohio
Concord, N. H.
Elyria, Ohio, Water Co.
East Orange, N. J.
Grand Hotel, N. Y.
Grand Rapids, Mich.
Greenfield, Mass.
Guelph, Ont.
Gilbertsville, N. Y.
Hackensack Water Co.
Hartford, Conn.
Holyoke, Mass.
Hudson River Hospital
Hudson, N. Y.
Indianapolis, Water Co.
Jersey City, N. J.
Johnson & Johnson Mfg. Co.
Kingston, N. Y.
Lake Placid
Lancaster, Pa.
Lawrence, Mass.
Lima, Ohio
Lincoln, Mass.

Lorain, Ohio
Lynn, Mass.
Menominee Water Co.
Miami Water Co.
Minneapolis
Montclair Water Co.
New Brunswick, N. J.
Newburgh, N. Y.
New Jersey Zinc Co.
New York City
Norfolk, Va.
Northampton, Mass.
Nyack, N. Y.
Oswego, N. Y.
Ottawa, Ont.
Painesville, Ohio
Palmer Water Co., Palmerton, Pa.
Peoples Water Co., Oakland, Cal.
Peterboro, N. H.
Philadelphia, Pa.
Piqua, Ohio
Pittsburgh, Pa.
Plainfield Water Co.
Portland, Me.
Poughkeepsie, N. Y.
Providence, R. I.
Reading, Pa.
Rockefeller Estate, Tarrytown
Rutland, Vt.
Saginaw, Mich.
St. Albans, Vt.
St. Johns, N. F.
St. Louis, Mo.
St. Thomas, Ont.
Salem & Beverly, Mass.
Salisbury, Md.
Salisbury, N. C.
San Francisco, Cal.
Saranac Lake, N. Y.
Saratoga Springs
Springfield, Mass.
Toledo, Ohio
Trenton, N. J.
Tuxedo Park, N. Y.
Vassar College
Vergennes, Vt.
Wallingford, Conn.
Washington, D. C.
Watertown, N. Y.
Waterville, Me.
West Point Military Academy
Wilmington, Dela.
Winnipeg, Man.
Yonkers, N. Y.

GENERAL ADVICE REGARDING SEWERS AND SEWAGE DISPOSAL

Altoona, Pa.
Bay Head, N. J.
Cincinnati, Ohio
Cleveland (State Board of Health)
Englewood, N. J.
Guelph, Ont.
Hudson River Hospital
Louisville, Ky.
Millbury, Mass.
Milwaukee, Wis.
Northampton, Mass.
Passaic Valley Sewerage Com.
Paterson, N. J.
Penna. State Lunatic Hospital
Pittsburgh, Pa.
Poughkeepsie, N. Y.
Rochester (State Board of Health)
Vassar College
Westbrook, Me.
Willsboro, N. Y.

FILTRATION PLANTS DESIGNED

Albany, N. Y., covered sand filters.

Auburn, N. Y., not yet built.

Brisbane, Queensland (building).

Hartford, Conn., covered sand filters, not built.

Hudson River Hospital, covered sand filters.

Ithaca, N. Y., mechanical filters.

Ogdensburg, N. Y., covered sand filters.

Ottawa, Ont., mechanical filters, two plants on different locations, not yet built.

Peekskill, N. Y., covered sand filters.

Pennsylvania State Lunatic Hospital, Harrisburg, open sand filters.

Red Bank, N. J., open sand filters.

Springfield, Ludlow supply, intermittent filters; Little River supply, covered sand filters. These filters were included as part of an entirely new source of supply, consisting of dams, pipe lines and other structures.

Superior, Wis., covered sand filters.

Toronto, Ont., covered sand filters.

Washington, D. C., covered sand filters.

Watertown, N. Y., mechanical filters.

Yonkers, N. Y., open sand filters and two separate additions of covered sand filters.

VALUATION CASES

Athol, Mass., value of plant for the town.

Augusta, Maine, for the city.

Cortland Water Co., for the company. (Plant sold to city without litigation).

Denver Union Water Company; member of board of five engineers; two selected by city and two by company; Mr. Hazen acted jointly for company and city.

Des Moines Water Company, for the company.

Gardner Water Company, for the company.

Gloucester, Mass., for the city.

Ithaca Water Works Company, for the company.

Newburyport, Mass., for the city, value of filters, etc.

Racine Water Company, for the company.

Spring Valley Water Co., (supply for San Francisco, Cal.), for the company; now in progress.

Staten Island Companies, for the City of New York.

Waterly Water Company, for the company.

Wildwood Water Works Co., for the company.

Wilmington, Clarendon Water Co., value of plant, agreeing on value with city's representative.

Portland, Me., value of physical property for the city.

Hackensack Water Co., (supply for some 300,000 people in New Jersey), for the Bergen County Freeholders.

ASSISTANCE IN LITIGATION

Butler Water Company, infringement suits.

Bangor, Maine.

Gloversville, N. Y., sewerage.

Millbury, Mass., sewerage.

State of Missouri vs. Chicago Drainage Canal.

Denver Union Water Co.

MISCELLANEOUS WORK

Charles River Dam, advice to parties regarding construction work on the river.

Florida Everglades; drainage of certain lands.

Isthmian Canal, member of board of engineers, 1909, reporting on Gatun dam and general condition of work at the Isthmus.

The above is not a complete list. Smaller places and certain other work not included.